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# The Impact of Focused Tutoring and Science Lab Instruction Strategies for An Elementary School in South Texas

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# THE IMPACT OF FOCUSED TUTORING AND SCIENCE LAB INSTRUCTION STRATEGIES FOR AN ELEMENTARY SCHOOL IN SOUTH TEXAS

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# ABSTRACT

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The purpose of this study was to determine the effect that focused tutoring and science lab methodologies have on 5th grade student performance in science. The study examined how focused tutoring and science lab methodologies affect performance of 5th grade students in science as measured by Texas Assessment of Academic Skills (TAKS). The problem is that far too many young Americans emerge from the nations elementary and secondary schools with an inadequate grounding in science. In correlation with this problem, if adequate instructional interventions are implemented, then students may be better prepared when tested with the science Texas Assessment of Knowledge and Skills (TAKS). The research question posited is: What are the effects of focused tutoring and science lab methodologies on science academic performance? The need for the study was based on poor student performance on TAKS and the limited knowledge of current administrators in the area of proven instructional strategies to help 5th grade student pass science TAKS. The rationale was that the use of focused tutoring and science lab methodologies might assist students in mastering objectives tested on the 5th grade Science TAKS test. The first assumption was that focused tutoring and science lab methodologies were being correctly implemented at the elementary level. A second

assumption was that focused tutoring and science lab methodologies might positively impact 5th grade Science TAKS scores. The limitations of this study were the school geographic location, the content knowledge of the teachers, and the fact that science labs had only been in operation for three years at the time of the study.

# DEDICATION

The following work is first and foremost dedicated to my almighty God and Savior Jesus Christ who provided me with the inspiration that all things are possible in life. "I can do all things through Christ who strengths me." *Philippians 4:13*

Next, I thank my beautiful daughter Annika S. Rodriguez, who supported me through her words of encouragement and patience. Annika, you have been such an inspiration in my life since the day you were born. Thanks for understanding mommy's absence or joining in on my studies while I strived to be the best mom possible. I trust to have modeled for you that anything in life is possible as long as you have the desire and drive. You are the most important person in my life and I love you very much.

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# CHAPTER I

## INTRODUCTION

In the past two decades, a number of unprecedented attempts to reform schools across America have been made. Although the reforms have been integrative and overlapping, their effects have been characterized as constituting separate "waves" (Desimone, 2002). *A Nation at Risk (*National Commission on Excellence in Education, 1983) altered an intensification of the system that was in place at that time. One of the major concerns of the report was that although a large amount of funds had been allocated for public school systems to improve science instruction in the past 50 years, science achievement continued to show little improvement in the schools. To that effect with reference to the U.S.S.R. the concern concluded that .....

> An unfriendly power had attempted to impose on America the mediocre educational performance that exists today; we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves. We have even squandered the gains in achievement made in the wake of the Sputnik challenge. Moreover, we have dismantled essential support systems which helped make those gains possible. We have, in effect, been committing an act of unthinking, unilateral educational disarmament. (p. 5)

This was part of the first wave of reforms which called for systemic changes, such as increasing standards and regulations, which resulted in increased teachers'

salaries, increased core requirements, and a lengthened school day and year (Boyer, 1990).

To hold states accountable, the federal government became involved in 2002, by legislating the No Child Left Behind Act. In correlation with Elementary and Secondary Act of 1965, the No Child Left Behind Act was aimed at holding states accountable for student achievement when using federal funds. In response, states are required to develop student academic assessments that include, at a minimum, assessments in reading/language arts, mathematics, and science (Abedi, 2004). The states are required to report student progress, in terms of percentage, for students scoring at the proficient level or higher.

In the effort to focus on teaching and learning while meeting such mandates as the No Child Left Behind Act, educators must change not only the structure and organization of schools but the curriculum and the delivery of instruction. In view of this need to change, in the lower Rio Grande Valley of Texas, educators struggle with students' lack of science knowledge to master the objectives set forth by the Texas Assessment of Academic and Skills (TAKS) exam. So, in their quest to meet the needs of 5$^{th}$ grade students mastering the science assessment, administrators have implemented additional instructional interventions for students. Two of those interventions are tutoring and science labs.

Texas response to the accountability movement forced by the Nation at Risk Report (1983) and later the No Child Left Behind Act (2002) evolved to the current Texas Assessment of Knowledge and Skills (TAKS). According to guidelines set by the state, fifth grade students must pass both the reading and math TAKS in order to be promoted to the next grade level. Of the students who tested during the first or second test

administration of 2006, 90 percent passed the reading exam in English or Spanish. In order to ensure student success on the TAKS, a majority of administrators are implementing additional instructional interventions to the school day and week.

Although, the success in reading and math has increased yearly, the performance of students in the area of Science continues to be low in the state of Texas. This is particularly evident in the Rio Grande Valley which is largely comprised of low socio-economic Hispanic students. One of the reasons Science instruction did not become a major focus in elementary classrooms until recently, was the fact that the state accountability system did not mandate science assessment as early as the 5th grade until 2003.

*Statement of the Problem*

According the Educational Testing Service, (1988), far too many young Americans emerge from the nations elementary and secondary schools with an inadequate grounding in mathematics, science and technology. As a result, they lack sufficient knowledge to acquire the training, skills and understanding of science content that is needed for the 21$^{St}$ century.

In the United States, schools today are being asked to overcome barriers that stand in the way of adequate preparation in science for the next century. A problem that is apparent is the low level of scientific knowledge among members of the United States population. In 1991, Miller reported that only about 6% of American adults are knowledgeable about science facts and theories and, according to the International Association for Evaluation of Educational Achievement (1988), U.S. students' test results compare unfavorably with those of students from other countries.

In the school setting, there are teachers who graduate and obtain an elementary certification which allows them to teach in a setting instructing all subjects. Consequently, science is said to be taught poorly in schools because teachers lack preparation, science activities are poorly designed, and standards for performance are too low (Aldrige, 1992).

The alarming sense of inadequacy of Science instruction has led to the development of three national-level proposals for science education reform. These include the American Association for the Advancement of Science (AAAS) Project 2061 (AAAS, 1993; Rutherford & Ahlgren, 1990); the National Science Teachers Association's (NSTA) Project, on Scope, Sequence, and Coordination of Secondary School Science (Aldridge, 1992; NSTA, 1992, 1995); and the National Research Council's (NRC) National Science Education Standards (1994).

These proposals view "scientific literacy" for all Americans as the educational solution to the problem of lack of science knowledge and urge the nation to make it the overarching goal of science education reform (Eisenhart, Finkel, & Marion, 1996). In Texas, until 2003, students in 5th grade struggled with mastering the Science portion of the Texas Assessment of Knowledge and Skills because the emphasis at the earlier grade levels was focused on reading, writing and arithmetic. This study provides research over the implementation and effects of two specific instructional interventions implemented at an elementary school, designed to increase mastery of science objectives for TAKS.

*Purpose of the Study*

The purpose of this study was to determine the effect that focused tutoring and science lab methodologies had on 5$^{th}$ grade student performance in science. The study examined how focused tutoring and science lab methodologies affected performance of 5$^{th}$

grade students in science as measured by Texas Assessment of Knowledge and Skills (TAKS). The intent was for the research to be of use to administrators who are searching for methodologies to improve 5th grade science TAKS performance.

Periodic reviews of research in any area, such as school reform, are necessary to evaluate the quality and consistency of the evidence on initiatives and to examine the utility of approaches and methodologies central to the investigations (Chatterji, 2002). There has been much research generated to date on standards based reforms and the associated accountability movement. Studies have charted the systematic reform movement as it coursed its way from the highest national levels to various state levels, ultimately reaching school systems and individual schools across the nation.

Research on diverse ways of knowing, doing, and talking science is slowly emerging (Czerniak & Chiarelott, 1990). The research suggests that an instructional approach is needed that establishes congruence between the nature of science and the language and cultural experiences of students. There has been little consideration given to the background knowledge and experiences teachers bring the instruction of science as a subject instructional congruency needs to be in place for students to learn science. To this effect, teachers must have (a) an understanding and appreciation of students' language and cultural experiences, (b) scientific knowledge and habits of mind, and (c) abilities to relate science to students' background experiences (Desimone, 2002).

In recent decades, high sustained birth and immigration rates of students from diverse languages and cultures have made the need for effective instruction compelling (Improving America's Schools Act, 1994; U.S. Department of Commerce, 1993). The overall percentage of English Language Learners in public schools has increased

dramatically. The increase in English Language Learners underscores the importance of identifying the challenges facing this population not only in learning English but also in learning science. There is also a compelling need for the development of a comprehensive knowledge base to provide effective science instruction. Addressing the educational needs of students in the area of science, in view of the challenges, is one of the many difficulties educators face every day.

The approaches and supplemental instruction to meet the standards of scientific literacy among students is vital in today's schools. At the study site, additional tutoring in Science and hands on methodologies in the science lab were implemented as instructional strategies to meet the needs in the area of science with all students. This study reviewed these methodologies and their effect on student achievement.

*Need for the Study*

The need for this study was based on the limited knowledge of current administrators in the area of proven instructional strategies to help 5$^{th}$ grade students pass science TAKS. This study determined if and how focused tutoring and science lab methodologies affected student achievement. In response to the 5$^{th}$ grade science TAKS test, science labs and tutoring have been implemented across the state to meet standards on the exam.

*Assumptions*

The following assumptions were acknowledged in this study: 1) The science lab was adequately equipped with resources 2) The teachers providing tutoring were knowledgeable in science content 3) The teachers were knowledgeable in focused tutoring and science lab instruction approaches.

*Research Question*

The guiding question for this study was as follows:

What are the effects of focused tutoring and science lab methodologies on science academic performance?

*Research Hypotheses*

The research presented in this study delineated the need for improving science instruction at the elementary level. Desimone (2002) reported that school improvement should not only focus on one particular form of intervention, but that educators shall see the functions of all parts of a school system to ensure success. This study tested the following research hypotheses:

*Hypothesis 1.* There is a difference among cohort means.

*Hypothesis 2.* There is a difference between pre-treatment means and post-treatment means.

*Definition of Terms*

*Comprehensive School Reform.* An approach to school improvement which is intended to foster school-wide change that affects all aspects of schooling curriculum, instruction, organization, professional development, and parent involvement. For the purpose of this study, school reform will focus on curriculum and instruction, specifically in the area of elementary science.

*Hispanic.* The term Hispanic as defined by the Texas Education Agency, Public Education Information Management System (PEIMS) is a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race. For this study the large majority of Hispanics will be of Mexican descent.

*Study Site.* The study site had 791 students enrolled of which 99 percent were Hispanic and 80 percent were an at-risk population. The site was an elementary school campus in a small populated urban city in the Lower Rio Grande Valley.

*AYP.* By the year 2000-2001, states were required to have in place assessments that were aligned to the state standards and that met other requirements of state and federal law. States were required to define "adequate yearly progress" of any recipient school or local educational agency toward enabling all students to meet the state's standards, as determined by student performance on the state assessments. U.S. Department of Education (1997), p. 61.

*Texas Assessment of Knowledge and Skills (TAKS).* A comprehensive testing program aligned to the Texas Essential Knowledge and Skills (TEKS) curriculum in grades 3-11 for public school students. It was intended to measure the extent to which a student had mastered the concepts and skills expected within each grade level. Students were scheduled to be tested in the spring semester of each school year in the following subjects:

a. Reading at grades 3-9;

b. Writing at grades 4 and 7;

c. English Language Arts at grades 10 and 11;

d. Mathematics at grades 3-11;

e. Science at grades 5, 10, and 11; and

f. Social Studies at grades 8, 10, and 11.

g. The Spanish TAKS is administered at Grades 3 through 6.

*American Association for the Advancement of Science.* An international non-profit

organization with the stated goals of promoting cooperation between scientists, defending scientific freedom, encouraging scientific responsibility, and supporting scientific education and science outreach for the betterment of all humanity. It is the world's largest general scientific society, with nearly 120,000 individual and institutional members in 2007, and publisher of the well-known scientific journal, Science.

*National Science Teachers Association.* Founded in 1944 and headquartered in Arlington, Virginia, it is the association of science teachers in the United States and is the largest organization of science teachers worldwide. NSTA's current membership of more than 57,000 includes science teachers, science supervisors, administrators, scientists, business and industry representatives, and others involved in and committed to science education. The organization's mission is to "to promote excellence and innovation in science teaching and learning for all."

*Focused Tutoring.* A self-paced learning exercise; a lesson prepared so that a student can learn at their own speed, at their convenience. For the purpose of this study, 5th grade students received one on one tutorial help four times a week by a professional teacher focused on science methodologies implemented in the science lab.

*Science labs.* A facility that provides controlled conditions in which scientific research, experiments, and measurement may be performed. The title of laboratory was also used for certain other facilities where the processes or equipment used were similar to those in scientific laboratories. In the study site, students were instructed with hands on experiments in a lab setting two or three times a week.

*Limitations of the Study*

A limitation in the study was the school geographic location which is reflective of the school population. The majority of the student enrollment was Hispanic of Mexican descent. A more diverse population might produce different results. A second limitation was the content knowledge a teacher has in the area of science. Students receiving additional instruction in the form of focused tutoring by a teacher who is knowledgeable in science content may score higher on the science TAKS exam versus students receiving tutoring from a less knowledgeable teacher. A third limitation was that the utilization of the science labs at the study site reflected only three years of implementation. It might be too soon to draw lasting effects or conclusions based on the limited implementation period.

*Summary*

This chapter presented an introduction to the study that discussed the following:

1) Introduction 2) statement of the problem, 3) purpose of the study, 4) need for the study, 5) assumptions, 6) research questions, 7) research hypotheses, 8) definition of terms, 9) limitations of the study, and 10) summary. Chapter 2 comprises a literature review encompassing: 1) science literacy 2) research on science performance, 3) the need for a systemic approach to school reform, 4) tutoring practices and 5) the impact of science labs in the classroom.

# CHAPTER II

# REVIEW OF LITERATURE

The purpose of this study was to determine the effect that focused tutoring and science lab instructional methodologies had on 5th grade student performance in science. This chapter focuses on: 1) science literacy, 2) research on science performance, 3) the need for a systemic approach to school reform, 4) tutoring practices and 5) the impact of science labs in the classroom.

## *Science Literacy*

In the Third International Mathematics and Science Study (TIMSS), the general knowledge of science and mathematics among students, U.S. 12th graders ranked the lowest from the 41 nations participating. The TIMMS study proved what has been evident for decades: "Most U.S. students, even the brightest, are failing to learn much that is useful in science, mathematics and technology (Schmidt & Prawat, 1999). Since our world continues to become more scientific and technological, our future is more dependent on how we as humans use science. This is dependent on the effectiveness of the science education received by our students. Some suggest that the effectiveness is lacking as evidenced by the following quote:

> Far too many (young Americans) emerge from the nation's elementary and secondary schools with an inadequate grounding in mathematics, science and technology. As a result, they lack sufficient knowledge to acquire the training, skills and understanding that are needed today and will be even more critical in the 21st century (Educational Testing Service, 1988., p. 4).

Traditionally, teachers in early grades have been directed by administrators to improve basic reading, writing, and mathematics skills. In Texas, science instruction had been minimized because science was not tested for state accountability purposes. The lack of "disconnect of science to math, social studies, and literacy and its marginalization in the elementary curriculum shows its subversive effects ranging out from low state scores on SAT exams to the low performance of American students on the TIMMS and Program for International Student Assessment (PISA) reports" (Valverde & Schmidt, 1997). It seems that while the state was trying to meet reading, writing, and mathematics scores on high-stakes testing, as prescribed by the No Child Left Behind Act, science in the elementary grades was being left behind.

Proponents of science education have faced no greater obstacle than federally mandated testing in reading and mathematics, which forced teachers to devote the majority of the instructional school day to those two subjects. Only recently, the provision of the No Child Left Behind Act requires states to begin testing students in science. Now, educators have refocused their attention to include science as a priority in instruction. It seems that in addressing this new requirement educators are facing the reality that students are currently poorly prepared in the area of science (Cavanagh, 2007).

The alarm nationwide on the lack of preparation of students in the area of science, led to the development of three national-level proposals for science education reform. These include the American Association for the Advancement of Science's (AAAS)

Project 2061 (AAAS, 1993; Rutherford & Ahlgren, 1990); the National Science Teachers Association's (NSTA) Project on Scope, Sequence, and Coordination of Secondary School Science (Aldridge, 1992); and the National Research Council (NRC) National Science Education Standards (1994).

The three proposals viewed "scientific literacy" as the educational solutions to overcoming four problems United States schools must overcome for adequate preparation in science for the next century. Miller (1991) reported that only about 6% of American adults are knowledgeable about science facts and theories and, according to the International Association for Evaluation of Educational Achievement (1988), U.S. students' test scores are lower than students from other countries. The second problem is that science is poorly taught in schools because many teachers are underprepared, the design of science activities is poor, and performance standards are low (Aldridge, 1992). In addition, citizens are not prepared to use scientific knowledge in their lives when making decisions (Rutherford & Ahlgren, 1990).

The *National Science Education Standards* emphasize the importance of a vision with a scientifically literate population. They stress both excellence and equity, by setting standards which outline what students need to know, understand, and be able to perform to be scientifically literate. The standards focus on giving the students the opportunity to learn science. Students will not achieve high levels of performance if they are not instructed by skilled professional teachers, provided adequate classroom time, and a variety of instructional material, work space, and all available community resources (National Research Council, 1996).

Students engage in the study of science with a variety of perceptions based on

their everyday experiences. Teachers must become aware of those ideas in order to help students understand science. According to Donovan and Bransford, the instructional challenge of working with students' preconceptions varies because some conceptions are more firmly rooted than others. Although, teachers must keep in mind that preconceptions are based on the everyday experiences of students.

The rigor of the Texas Assessment of Knowledge and Skills (TAKS) in the area of science has challenged educators to realize that fifth grade students are not adequately prepared in the area of science. The lack of science literacy among students is evident in the TAKS science results in comparison to the results in the area of reading and mathematics. In an effort to meet the criteria set by the state and in order to address low science performance, the administrators at the study site provided focused tutoring and science lab methodologies for students during the school day.

*Research on Science Performance*

According to the 2005 National Assessment of Educational Progress (NAEP), in comparison to middle and high school students, students of younger ages are making more progress in science. The study, which included the state of Texas, reflected that of 300,000 students in 4th, 8th and 12$^{th}$ grade that were represented, most states, showed no improvement in grades 4th and 8$^{th}$. According to the *Nations Report Card,* "The percentage of students performing at or above the *Basic* achievement level increased from 63 percent in 1996 to 68 percent in 2005 (p.1). On an average in 4$^{th}$ grade, Hispanic students demonstrated an 11 point gain since 2000.

The report card also highlighted that minority students in grades 4 and 8 are making progress. The average scores for 4$^{th}$ grade African American students increased

by 7 points and for Hispanics by 11 points, since 2000. White and Asian/Pacific Islander fourth-graders also showed improvement since 1996. The state of Texas was included in the report card findings with the Hispanic population representing only 19% of the 3,000 students tested versus 59% of white student representation.

In 1999, the 76th Texas Legislature addressed the accountability for science performance on state mandated assessments. During the 2002-2003 school year, the Texas Assessment of Knowledge and Skills (TAKS) was mandated by the Texas Education Agency which assessed reading at Grades 3 through 9; writing at Grades 4 and 7; English Language Arts at Grades 10 and 11; mathematics at Grades 3 through 11; science at Grades 5, 10, and 11; and social studies at grades 8, 10, and 11. In Grade 11, students must attain satisfactory performance as a prerequisite for a high school diploma (Texas Education Agency, Assessment and Testing Division, 2008). The new assessments addressed a correlation to the Texas Essential Knowledge and Skills by increasing student achievement expectations. This further pressured public schools to rise to the standards set by the state via TAKS.

The TAKS test was intended to measure the extent to which students have learned and are able to apply the knowledge and skills at each tested grade level. Every TAKS test was composed with much input from Texas educators to be directly aligned to the Texas Essential Knowledge and Skills (TEKS) (Texas Education Agency, 2008). In fact, thousands of educators served on committees in the Texas assessment program. The committees were representative of the state geographically, ethnically, by gender, and by type and size of school district. The purpose for this widespread involvement of educators was to increase the validity and credibility of the testing program.

On the other hand, proponents against high stakes testing have voiced concerns which suggest that testing can be a driving force behind fundamental change within schools (Koretz, Linn, Dunbar, & Shepard, 1991). Although, there is a difference of opinion as to whether this change is for better or worse. For example, while some feel that the guarantee of rewards or the threat of sanctions is essential for the promotion of quality teaching and encouraging higher student achievement, others have found that high-stakes tests limit the scope of classroom instruction and student learning in undesirable ways (Stecher & Barron, 1999; Stecher, Barron, Chun, & Ross, 2000). Regardless of one's position on the issue of high-stakes tests, it is essential to note that statewide testing influences classroom instruction and student learning. The mere fact that it is state mandated is in itself a threat to be dealt with.

In addition, numerous research studies have analyzed how state-mandated testing programs with a focus on how high stakes attached to test results affects schools, teachers, and students. The studies gathered information from teachers and administrators by using surveys, interviews, classroom observations, and combinations of these methods. The studies focused on single states and varied nature of state testing programs in terms of the format, grade level, and subject areas tested. The results demonstrated both positive and negative results (Goertz & Duffy, 2003).

Although, high-stakes testing and accountability policies are here to stay, the challenge for policy makers and practitioners will be to make the system work in ways that benefit students and teachers. This can be accomplished by having well designed assessments and accountability systems which focus attention on schools and students who are in need of most help, while motivating students and educators, and fostering the

development of better curriculum and instruction (Abram, Pedulla, & Madaus, 2003).

In conclusion, research in school reform is necessary to evaluate the quality and consistency of the evidence on initiatives and to examine the utility of approaches and methodologies central to helping students. This study gained insight into an elementary school's strategic implementation of instructional intervention strategies such as tutoring and science lab experiences and the impact that these strategies have on student performance as evidenced by results on the 5th grade Science Texas Assessment of Knowledge and Skills exam.

*Schools as Social Systems*

The central purpose of this study was to determine the effect that focused tutoring and science lab methodologies might have on 5$^{th}$ grade student performance in science. The use of these teaching methodologies can be viewed as school reform efforts to directly address the aspects of schooling to improve academic achievement. Also, "if they are to be effective, educational reform efforts must anticipate that schools, like other social systems, can adapt to pressures for changes without changing" (Hawley, 1988).

Schools are social institutions in that they are complex and their activities are interdependent (Hawley, 1988). Small efforts, in and of themselves, to reform schools are not likely to be long term or successful. In order for educators to implement long lasting improvements, they must understand what instructional interventions influence students to learn. The task of identifying ways to improve achievement requires that educators look beyond programs to make the difference. According to Hawley, Rosenholtx, Goddsten, & Hasselbring (1984), the best process is for educators to examine the nature of the teaching-learning process in areas which changes might occur in the abilities and

motivation of children and the personnel that help them learn.

There are four general ways that schools and school systems can improve the academic achievement of students:

- Students can be provided with better learning experiences;
- The quality and amount of learning resources can be increased (including curriculum, textbooks and supplementary materials, and available technology);
- The willingness for parents to support the learning process can be increased;
- The quality of the learning environment can be improved.

The conditions and practices can be grouped into three categories:

- The things principals and other administrators do, especially the recruitment, selection, retention, and motivation of capable personnel;
- The quality of information and training available to teachers and administrators; and
- The necessary resources.

"The importance of thinking of schools as social systems is that it draws attention to the likelihood that efforts to change a part of the system without changing those elements of the system with which that part interacts will not usually be effective (Bacharach, 1981; Baldridge & Deal, 1983; Gross, Giacquinta & Bernstein, 1971). For example, an effort to train a teacher to use new instructional strategies would not be effective if no support is present by the principal or peers towards the new strategy. Improvements in the curriculum or ways in classroom organization would not be productive unless teachers

understand and believe in the concepts and materials being presented and have the necessary skills to adapt the curriculum and classroom structures to student needs (Fullan, 2000).

The central task of school reform is to have resources that create conditions which have a positive influence on the students and the teachers. Although there are a number of efforts recorded, Vinovskis (1999), reported on the efforts which were initiated in the 1980s in developing national educational standards as follows:

- First the impetus that comes from disappointment with American students' performance in international assessments, particularly in mathematics and science.
- A second source of this movement emerges from the participation of governors, business leaders, and visionary educators in school reform during the past decade. Those men and women who understood the idea of strategic planning, who knew that a change process must begin by identifying goals, found that education was not accustomed to goal setting...
- A third reason for the movement for national standards is the example created by the National Council of Teachers of Mathematics, which has successfully developed voluntary national standards over the past several years.

In the literature documenting the history of reforms in U.S. education from 1983 to the present, the terms *systemic reform, standards-based reforms, national standards,* and *accountability* merge and intermingle. In more recent accounts of policy, analysts and

researchers, the standards-based reforms and accountability movement developed as an off shoot of the original "systemic" reform initiative. In this, the second phase, the federal government became increasingly involved in setting the education reform agenda on a national level. The term standards-based reform was used to refer to the ways in which individual states responded to the push for higher standards and school accountability (Chatterji, 2002).

The concept of systemic reform in U.S. education emerged in the 1980s (Smith & O'Day, 1991). Systemic reform was the first national attempt at making coherent but comprehensive changes in schools at the local level. The components of systemic reform for public schools where the following

1. The establishment of challenging standards in the academic disciplines that would define what students should know and be able to do;
2. Alignment of curriculum and instruction, assessment and accountability, and teacher certification and professional development with the new academic standards; and
3. Revamping of school governance structures, allowing schools and teachers greater autonomy in how they organized instructional programs to achieve high standards of student performance at the local level (Chatterji, 2002).

The systemic reforms' goal was to increase the authority of the states in setting educational goals and standards for accountability, as well as in providing the necessary resources and support for reforms. Local schools were given the power on how they constituted and delivered instructional programs to attain those educational goals. Central office at the school districts played the role of middle agents of reform, following agendas

set primarily by state authorities (Chatterji, 2002).

In the 1980's, a number of researchers and practitioners developed whole-school models or designs for school reform, such as Accelerated Schools, the Coalition of Essential Schools, the School Development Program, and Success for All (Cohen, 1995). Criticism of past education reforms charges that although they changed institutional structures, policies, or organizations, they did not activate the proper mechanisms to affect what teachers do in the classroom or how students learn.

The federal government became more involved in education in the 1990s, despite the initial intent of giving local schools and teachers' greater decision-making power in bringing about systemic reforms. According to Cohen (1995), important national events that influenced the standards movement were the Governors' Summit in 1994 (now known as "Goals 2000", and the reauthorization of Title I programs as a fiscal means to move schools and school districts to achieve Goals 2000.

The second wave of reforms was initiated based on the result of the first wave of reforms which did not add any capacity to the system because they relied primarily on top-down approaches (Hawley, 1988). These new reforms focused primarily on broadening and deepening the relationship between schools and families, addressing the needs of special groups of students, attracting and retaining effective teachers, upgrading teacher education, and restructuring teachers' roles to make them more professional (Carnegie Corporation, 1986). Despite the different attempts of reform, school organizations did not change much and neither did the way that teachers' taught (Tyack & Tobin, 1994).

Based on the failure of these earlier reforms and due to a renewed focus on the importance of restructuring schools to foster changes in teaching and learning, the nation embarked on what was considered a third wave of reforms. These new reforms focused on improvement for the entire school rather than on particular populations of students within the schools; and it is not limited to particular subjects, programs or instructional methods (Desimone, 2002).

In order to experience success in implementing such strategic reform and change in an organization, a leader must assure that effective relationships exist. The change process can be difficult for employees if practices have not been in place previously. A leader must provide opportunities for planning, directed at helping students who are experiencing deficiencies in academics. This has leaders taking a collegial role rather than a supervisor or managerial role. It is important for leaders to put into place a personal touch and demonstrate that they care when dealing with employees especially when implementing new strategic change with instruction (Desimone, 2002).

Students will not achieve high levels of performance if they are not instructed by skilled professional teachers; have adequate classroom time, and a variety of instructional material, work space, and all available community resources (National Research Council, 1996). In science, administrators face the problem that the content is poorly taught in schools because many teachers are underprepared, the design of science activities is poor, and performance standards are low (Aldridge, 1992).

In order to provide experiences that may help students understand science concepts, science laboratories have been implemented in the elementary schools. Laboratories have been a part of science courses since at least the late 1800s when science

was introduced into the U.S. curriculum. In the early 1900s demonstrations often supplanted laboratories and laboratories frequently served primarily to provide vocational skills (Linn, 1997). As science learning began to change, so did the role of labs in instruction. Eventually, vocational preparation constituted only a small portion of the science laboratory experiences available in schools. Today, the availability of technologies including simulations and real time data collection raises new concerns about the role of the science laboratory (Linn, 1997).

In response to a renewed focus on teaching and learning demanded by the reform movements, educators must fundamentally change not only the structure and organization of schools but the curriculum and the delivery of instruction. Educators continue to search for resources, time and strategies to prepare students for the rigid promotion standards based on state assessment.

The standards set forth the need to address the poor performance of students on the science TAKS. In response, administrators have implemented a variety of initiatives to assure students success on the assessment. Tutoring and science labs are among the most popular instructional interventions being implemented. This study tested the effectiveness of tutoring and science labs methodologies as compared to traditional methods on fifth grade student achievement in science.

*Tutoring Practices*

Tutoring, one of the oldest teaching strategies is used to supplement instruction in today's schools. Long before Emile, possibly before Plato, tutoring was hypothesized to be superior to other instructional methods and class sizes (Bausell, Moddy & Walzl, 1972). Although there are practical constraints, supplementary or remedial tutoring is

being increasingly implemented with severely academically deficient children. Furthermore, in Texas, the practicality of individualized instruction has been increased due to the rigid demands for grade level promotion due to the Texas Assessment of Knowledge and Skills (TAKS).

The tutoring programs offered in many elementary and secondary schools today differ in an important way from yesterdays' tutorial programs. In the early days, tutoring was limited to the elite by the classroom teacher. The practice changed to children tutored by peers or paraprofessionals rather than by regular school teachers or professional tutors. In response to the guideline of passing the state exam in Texas in order to be promoted to the next grade level, educators have implemented a variety of tutoring techniques to help students in need of additional assistance in today's schools.

In addition, if the fact that teacher training and experience are not a requisite for successful teaching, then it would appear that non-professional manpower might be tapped for tutoring services (Bausell, Moody and Walzl, 1972). There have been several comparisons in which several programs have been instituted in which tutoring by non professionals plus classroom instruction has been compared to classroom instruction alone. Tutoring plus classroom instruction generally leads to increased achievement, although not always (Niedermeyer and Ellis, 1970). Unfortunately, since total instructional time is not controlled, this line of research does little to answer the theoretically and practically important question: does tutoring result in greater student achievement than does classroom instruction? (Bausell, Moody and Walzl, 1972).

Through traditional methods instructional sequence and pace are held constant for all students in the classroom. Since teachers usually gauge their instruction for the

average student, some students never acquire the instruction needed to master the objective.

As educators continue the struggle to meet academic standards set by the state, additional instructional help for students is added to the school day through tutoring. Tutoring has proven to be beneficial as accounted for through study of the tutor, the student, the program, the environment, or a combination. In a factorial study of tutoring versus classroom instruction by Bausell, Moody, & Walzl, in 1972, it was assumed that tutoring is more effective than large group instruction. Although, according to the study, its superiority had never before been demonstrated, the study focused on explaining tutoring effectiveness. Bausell, Moody & Walzl further concluded that, "One reasonable explanation is that although absolute instructional time was constant for the two conditions, effective instructional time was probably not equivalent" (p. 596). This particular study demonstrated that through one-to-one tutoring interventions and on-going informal diagnostic analysis by teachers, instruction became more meaningful and focused specifically on student's needs.

Cohen, Kulik and Kulik (1982), in a study which involved a meta-analysis of findings in tutoring programs from 65 independent evaluations of schools, demonstrated that "these programs have positive effects on the academic performance and attitudes of those who receive tutoring" (p. 237). Students who were tutored, outperformed control students on assessments, and developed a positive attitude towards the subject in which they were being tutored. The meta-analysis also demonstrated that students who served as tutors were also positively affected by their involvement (Cohen, Kulik & Kulik, 1982).

Although, for many years there have been a large number of after school programs for school age children, the No Child Left Behind (NCLB) Act of 2001 has focused schools with new attention to provide additional instructional intervention through after school tutoring. Under the current law, districts must offer tutoring in schools that fail to make adequate yearly progress (AYP) for three consecutive years. All students eligible for NCLB's Title I program may receive such tutoring paid for by the federal program. Schools that fail to help all children reach proficiency are required to provide supplemental educational services. These services must occur outside the school day and be backed by evidence that the services are effective in raising student achievement (No Child Left Behind Act of 2001, section 1116 [e].

According to Viadero (2007), five years after the No Child Left Behind Act became law, there is still little research evidence to show whether one of the federal measure's least-tested innovations, a provision that calls for underperforming schools to provide after-school tutoring, has an impact on student achievement. An estimated 500,000 students nationwide will be receiving free tutoring under the law within this next school year, "most studies of its supplemental educational services, or SES, provision track how states and districts are implementing the requirement." (Viadero, 2007) Experts overseeing the effectiveness of supplemental educational services or tutoring estimate that only Georgia, New Mexico and Tennessee and districts in Chicago, Los Anglees, Minneapolis, and Pittsburgh have looked to see if these services have impacted student achievement. On the other hand, the studies demonstrate a mixture of success. Although, parents report satisfaction with services provided for students, the studies find that the added hours of tutoring have produced small gains on reading and mathematics

tests (Viadero, 2007).

Sunderman (2006) finds that programs offered outside the regular school day or during the summer have demonstrated limited success; research does offer approaches that have been beneficial in impacting student achievement of disadvantaged students. Research based on the implementation of Title I suggests that students benefit from schools that implement an approach which includes supplemental instruction that is coordinated with the regular curriculum, provides programs that support instruction which students receive in the core curriculum and sets expectations that are equal for all students (Sunderman, 2006).

In addition, research has identified that a strong relationship between feedback and achievement can be accomplished through one on one tutoring. Marzano (2003) provides a review of relevant research in *What Works in Schools: Translating Research into Action.* Marzano indicates that "academic achievement in classes where effective feedback is provided to students is considerably higher than the achievement in class it is not" (p. 37). Marzano highlights two specific characteristics that he feels are essential for improving student learning. He explains that feedback must be timely and that it must be specific content at hand. In essence, the goal should be to provide relevant feedback while avoiding confusion which can result from the introduction of extraneous information (Marzano, 2003).

The ability to provide frequent formative information can support the advocates of tutoring programs. Tutoring is efficient in these terms given that the activities are a constant flow of formative information. Tutoring activities encourage the tutor to provide both timely and content-specific feedback, thus processing the two essential

characteristics set forth by Marzano (2003). In this light, tutoring is ideally suited for meeting the needs of students, particularly those in academic failure.

Furthermore, extensive research demonstrates that emotional, social and cognitive differences among students affect how each student responds to instruction (Gardener, 1999). For this reason, no one type of instruction is universal and different types of instruction are effective for different students. In order for a tutoring program to be effective, it must meet the varying instructional needs of students (Greer, 2006). By understanding the personal interests of students, likes and dislikes, and individual abilities, instruction can be geared towards each individual student in order to make his or her learning experience personal and highly beneficial (Al-Hazza & Gupta, 2006). According to Al-Hazza & Gupta (2006), individualized instruction should include:

- Lesson plans designed around the skill base of each student;
- Adaption to each student's individual needs;
- Adaptation to each student's individual pace;
- Recognition of and adaptation to each student's learning style or preference;
- Recognition and use of positive reinforcement that each student finds most rewarding;
- Provision of instruction geared toward the personal interests of each student, when possible;
- Instruction geared toward the skill gaps identified for each student (based on provider's pre-test and goals set out in the SES agreement).

The study site supplemented instruction and reflected the above mentioned recommendations with focused tutoring. Students were provided with one on one instructional support during the day and after school. The teachers provided developmentally appropriate practices to help students achieve mastery. The developmentally appropriate practices for tutoring by Al-Hazza & Gupta, 2006; Greer, 2006; Johnson, 2006; Juel, 1996; NAEYC, Osberg, 1997; Shumow, 2001; Stipek, 2006 are recommendations followed by teachers at the study site (Appendix A). Teachers extended classroom instruction and focused on low performing areas in science based on six week assessment results. Low performing students were identified by the administration with input from teachers and scheduled for tutoring to meet the needs of the individual students.

In response to the national standards and the assessment of science on the 5th grade TAKS test, educators were focusing on creating an environment in which the learner was actively involved. Some elementary schools implemented science labs in the classroom to achieve the standards set by the state. Science laboratories helped students understand how to explain naturally occurring and everyday phenomena (Linn, 1997) which creates long term learning.

*Science Labs in the Classroom*

In the United States, a focus on science education had not been of high interest since the time the Soviets successfully launched Sputnik. The renewed focus is due to new curriculum and assessment requirements at the state and federal level. For example, the No Child Left Behind Act mandates that states test student science proficiency in elementary school (grades 3-5), in middle level (grades 6-9), and in high school (grades

10-12). Texas implemented the Texas Assessment of Academic Skills (TAKS) assessment to comply with the NCLB federal mandate.

At our nation's schools the teaching and learning of science has been a major educational concern. "Although a variety of approaches and methods have been explored and implemented during this time, recent reform efforts demonstrate a general consensus on basic principles for enhancing students' learning of science" (O'Sullivan, Weiss & Askew, p. 2). According to government agencies and professional organizations such as the National Science Board, the American Association for the Advancement of Science, the National Science Teachers Association, and the National Research Council there a several key goals for the delivery of instruction in science:

- Students should acquire a core of scientific understanding, including organized factual information.
- Students should acquire the ability to relate scientific concepts to each other and to problems they encounter in and out of school.
- Students should be able to apply science knowledge in practical ways.
- Students should be familiar with experimental design and have the ability to carry out scientific experiments that are developmentally appropriate.
- Students should acquire the science knowledge and understanding that will allow them the opportunity to pursue further study in scientific fields. (National Assessment Governing Board, 1995)

The research clearly states that it is essential that students learn science by involvement in the scientific inquiry process. The National Assessment Governing Board published in the Science Framework the distribution of estimated assessment time by

ways of knowing and doing science. Approximately 45 percent of assessment time is geared towards the measurement of conceptual understanding while scientific investigation is heavily emphasized at grade 4 than at grades 8 and 12. The authors voiced that this was a benefit since learning by doing plays a critical role for younger students, and ways of knowing in science should be introduced at an early age (O'Sullivan, Weiss & Askew, 1999). Table 1 displays the distribution of estimated assessment time by grade levels and demonstrates the conceptual understanding along with scientific investigation as a high emphasis in grade 4.

Table 1

*Distribution of estimated assessment time by ways of knowing and doing science.*

| | Grade 4 | Grade 8 | Grade 12 |
|---|---|---|---|
| Conceptual Understanding | 45% | 45% | 44% |
| Scientific Investigation | 38% | 29% | 28% |
| Practical Reasoning | 17% | 26% | 28% |

Since national and state assessments require elementary students to conceptualize while applying scientific investigations, it is critical that educators provide students with the adequate learning tools in science. "Scientific investigation, which is the ability to use the appropriate tools and thinking processes in the application of science;" are better provided

for students with facilities that are equipped for such investigations (National Center for Educational Statistics, 2005).

The new requirement in the area of science with NCLB along with standards set by government and professional agencies has forced educators to focus on science facilities which had previously been neglected. West (1999) states that, "An inadequate number of science labs have been built in recent years, and many of those that have been built are not designed to promote excellence in science education and improved student performance (p.48). The National Science Teachers Association (NSTA) has published guidelines for architects and school administrators to overcome the problem of inadequate science labs and classrooms (Biehle, Motz & West, 1999). Based on these recommendations, the determination is that laboratory classrooms should be designed with the following criteria in mind:

(1) All students should be able to face the teacher when they are in classroom mode;

(2) Sufficient space should be allotted so that students can work safely; and

(3) The teacher should be able to supervise the students easily and move around the room unimpeded. Paths for egress should be kept clear at all times (Biehle, Motz & West, 1999).

The purpose for science labs is to help students engage in the scientific inquiry process. This enables educators to engage students in a process of following step by step instructions while using measuring tools and collecting data. In addition, students must learn science as a process of inquiry that includes observation and imagination of the phenomena which is being studied.

Donovan & Bransford (2005) suggest that one of the most important aspects of science and yet one of the least emphasized in instruction is that science involves the processes of imagination. Students should be allowed to experience this process for themselves or science can seem dry and highly mechanical. "Indeed, research on students' perceptions of science indicates that they see scientific work as dull and rarely rewarding, and scientists as bearded, balding, working alone in the laboratory, isolated and lonely." If this were true, we would have few scientists that would remain in the field.

According to Motz, Biehle & West (2007), in order to enable excellence in science education, well –designed science facilities must be in place in our schools. This helps improve student performance and teacher retention. This is why the study site and many elementary school administrators have implemented science lab experiences to the instructional day

Along with science labs, focused tutoring in the area of science has also been a priority to achieve mastery of science concepts for students at the elementary level. It has long been assumed that tutoring and one on one instruction are more effective than large group instruction. There have been studies to examine tutoring versus classroom instruction (Bausell, Moody, & Walzl, 1974), but this literature review did not reveal any studies in the area of a combination of strategic interventions to improve Science TAKS scores with students in the Lower Rio Grande Valley. This is especially true since science continues to be the content area tested with the lowest average of students passing.

*Summary*

The review of literature presented a summary of the importance of science literacy, research on science performance, the implementation of additional instructional interventions through a systemic approach, the effectiveness of tutoring and the use of science labs as an additional methodology for teaching science concepts. The chapter outlined how tutoring and science lab instruction can address the low academic performance of students in the area of science.

The next chapter will address the following: 1) research design, 2) research questions and hypothesis, 3) participants and site selection, 4) instrumentation, 5) data collection procedures, 6) data analysis procedures, 7) limitations, 8) assurance of confidentiality, and 9) summary.

# CHAPTER III

# METHODOLOGY

The purpose of this study was to determine the effect that focused tutoring and science lab methodologies have on 5th grade student performance in science. This chapter describes the methodology used in conducting this study. The chapter is divided into the following subsections: 1) research design, 2) research questions and hypothesis, 3) participants and site selection, 4) instrumentation, 5) data collection procedures, 6) data analysis procedures, 7) limitations 8) assurance of confidentiality, and 9) summary.

## *Research Design*

Quantitative research involves the process of collecting numerical data in order to explain, predict, or control phenomena of interest (Gay & Airasian, 1996). This study presents a quantitative analysis of 6 years of 5th grade science TAKS data. This data is based on 2003 through 2008 science TAKS results. The campus studied is 1 of 10 elementary campuses in a school district in the Rio Grande Valley of South Texas. Figure 1, shown below, displays the research design for this study. This design provided for collection of test data on six cross-sectional cohort groups to determine the impact that instructional interventions (tutoring and science lab experiences) had on 5th grade TAKS results after intervention between cohort three and four. Cohorts one, two, and three provide base line data.

Cross Sectional Longitudinal Study

$O_1\ O_2\ O_3 X O_4\ O_5\ O_6$

*Figure 1.* Research design for the study.

Through a cross-sectional design the data were obtained at six data points, but from different groups (Gall, Gall, & Borg, 1996). The study involved a series of measurements taken from different cohorts over a six year time period.

The research reflects a causal-comparative research design to answer the research question posed in the study. Casual-comparative research attempts to determine reasons or causes, for the existing condition (Gay & Airasian, p. 337). This design was selected because the study was intended to demonstrate how tutoring and science labs impact the 5th grade science TAKS scores. This approach was selected as a means to analyze the effect while seeking the possible cause. The scores from three years were compared to analyze how tutoring and science labs impact the scores on the state assessment versus three years of scores where tutoring and science labs were not in place.

In a casual-comparative, or ex-post facto, research the researcher is attempting to determine "the cause, or reason, for existing differences in the behavior or status of groups" (Gay & Airsain p. 351). A casual-comparative study indentifies relationships that may lead a researcher to experimental studies but only a relationship is established. The design involved two groups (2002-2005, 5th grade students) and (2005-2008, 5th grade students) differing in independent variable and comparing them on a dependent variable. The lack of randomization, manipulation, and control were all sources of weakness. There was a threat of a possibility that the groups are different on some other major variable besides the identified independent variable.

The campus principal completed a questionnaire which identified the instructional interventions implemented for 5th grade science students to enhance their performance on the 5th grade TAKS (Appendix B). Based on the data, the researcher determined what instructional interventions were implemented for the years 2006 through 2008 of the study that were not implemented for years 2002 through 2005 . The school administration completed a survey which identified what was done differently in science in the years 2006 through 2008.

Through a one-way analysis of variance (ANOVA) effects of the treatment/intervention were derived and assessed. In this study, the researcher explains how student performance on science assessments was a function of instructional interventions using analysis of variance and trend analysis.

*Research Question and Hypotheses*

The study attempted to answer the following question:

What are the effects of focused tutoring and science lab methodologies on science academic performance?

*Hypotheses*

The research hypotheses were:

*Hypothesis 1.* There is a difference among cohort means.

*Hypothesis 2.* There is a difference between pre-treatment and post-treatment means.

*Null Hypotheses which were tested:*

*Null Hypothesis 1.* There is no difference among cohort means.

*Null Hypothesis 2.* There is no difference between pre-treatment and post-treatment means.

*Participants and Site Selection*

The defined population for this study was selected from a majority of Hispanic students in the fifth grade who took the science TAKS test during the 2003 through 2008 school years in an elementary school in South Texas. The student population attending this school was ninety-nine percent Mexican American and ninety-five percent of them were economically disadvantaged. The school is located in the Rio Grande Valley which is distinct from other areas of Texas due to its close proximity to Mexico. It is located 236 miles south of San Antonio and 152 miles south of Corpus Christi.

The study site was part of a large school district which has received a "Recognized" accountability rating from the Texas Education Agency for several years. The school in the study received a "Recognized" rating from the state for the 2007-2008 school year. According to the Texas Education Agency, the state accountability system was required to rate all districts and campuses if they served students in grades 1 through 12. The initial step was to identify the universe of districts and campuses that could be considered for a rating. The districts and campuses identified for standard procedures may then fall in one of the four primary rating labels (Exemplary, Recognized, Academically Acceptable, or Academically Unacceptable) (TEA, 2008).

The total number of students in the study ranged from eighty to one hundred and ten for each year. Science TAKS results were analyzed to understand the impact tutoring and science lab experiences have on scores for the different years.

For purposes of this study, the district superintendent was contacted to discuss the

Institutional Review Board and university procedures. Since the problem area had been on the performance of Hispanic fifth grade students in science, permission was requested from the study site, in view of the fact that scores had increased three years in a row. Once permission was granted, the study site was evaluated on how the implementation of focused tutoring and science lab methodologies had impacted 5th grade TAKS scores. The researcher concluded that the findings might prove to be beneficial for schools that were searching for alternatives to regular classroom instruction to increase TAKS scores in science. The study site was selected based on:

- a 12.8% increase in science scores within a two year time span,
- ninety-nine percent of the student population was Hispanic of Mexican descent

*Instrumentation*

In this study, in order to determine the effectiveness of focused tutoring and science lab experiences on academic performance in science, the Texas Assessment of Knowledge and Skills was analyzed for the 2006, 2007, and 2008 school years. In effect, the TAKS served as the instrument for analyzing data for this study. The state accountability system had been through several changes within the last several years. This was important in order to better understand the instrumentation process used in this study. State mandated assessments came into play in the state of Texas during the 1980-81 school years. During this assessment period students were tested in Reading, Writing and Math.

The TAKS test was intended to measure the extent to which students had learned and were able to apply the knowledge and skills at each tested grade level. Every TAKS test was composed to be directly aligned to the Texas Essential Knowledge and Skills

(TEKS) (Texas Education Agency, 2008). Texas educators played a vital role in the development of the tests. Thousands of educators served on committees which were representative of the state geographically, ethnically, by gender, and by type and size of school district.

*Data Collection Procedures*

Upon approval from the University of Texas-Pan American and the school district, the data needed for the study was retrieved from the TEA district TAKS science results for the school years studied. The student data was compiled and disaggregated into two groups, (1) student scores with no tutoring or lab experiences in science, or (2) student scores with tutoring and lab experiences in science.

*Data Analysis Procedures*

The obtained data was analyzed using a one-way analysis of variance (ANOVA). The null hypothesis for the present study was tested with a $\underline{F}$ distribution and the .05 level of significance. The $\underline{F}$ distribution reflects the distribution of the ratio of two estimates of variance. It is utilized to compute probability analysis of variance. If the null hypothesis is rejected, the Scheffé multiple comparison procedure will be utilized. The effect size was assessed through eta squared and Cohen's $\underline{d}$ value. Moreover, trend analysis and curve fitting was utilized to assess the six data points. In addition, to the confirmatory data analysis, exploratory data analysis was utilized (Tukey, 1977). The methods which are known as exploratory data analysis, which is a method for "discovering unforeseen or unexpected patterns in the data and consequently (for gaining new insights and understanding of natural phenomena (Leinhardt & Leinhardt, 1980).

*Limitations*

The following limitations were acknowledged in conducting this study:

1. The geographic location of the school is reflective of the population. The composition of the school's population is majority Hispanic. This might affect the results.
2. The knowledge of teachers in science varies which might influence the instructional content learned by the student during tutoring.
3. The implementation of science labs at the school reflected a time period of only three years.

*Assurance of Confidentiality*

"If the researcher has determined that confidentiality is essential to protect research participants, it can be provided in various ways" which a researcher should abide and implement (Gall, Borg & Gall, 1996, p. 92). This project was submitted for approval to The University of Texas Pan American Human Subjects Review Committee (HSRB) prior to conducting the study. The superintendent and administration of the school in study agreed to participate on a voluntarily basis. This study mainly focused on analyzing TAKS science test scores of 5$^{th}$ grade students and does not include any direct subject participation. The test scores for school X that were analyzed during the study reflected six years of data from 2002-2008 school years.

*Summary*

The purpose of this study was to determine the effect that focused tutoring and science lab methodologies have on 5$^{th}$ grade student performance in science.

The study addressed the following research question:

What are the effects of focused tutoring and science lab methodologies on science academic performance?

The literature cited in this study regarding the impact that science lab experiences have on student learning, based on assessment results, is limited. Although, the few studies conducted on the importance that additional learning opportunities such as a science lab setting or focused tutoring do demonstrate a positive impact on student learning. This study tested the following research hypotheses:

*Hypothesis 1.* There is a difference between pre-treatment means and post-treatment means.

*Hypothesis 2.* There is a difference among pre-treatment means and post-treatment means.

*Null Hypothesis 1.* There is no difference among cohort means.

*Null Hypothesis 2.* There is no difference between pre-treatment and post-treatment means.

Chapter 3 described the methodology used to test the research hypothesis in this study. The research design, participants, instrumentation, data collection procedures, data analysis procedures, limitations, and assurance of confidentiality were covered.

Chapter 4 will presents data analysis procedures used to conduct this study.

# CHAPTER IV

The purpose of this study was to determine the impact that focused tutoring and science lab methodologies may have on 5th grade student performance in science. More specifically, the study was conducted for the purpose of evaluating focused tutoring and science lab methodologies implemented at an elementary school in South Texas. Student performance was determined based on the science score results on the Texas Assessment of Knowledge and Skills (TAKS).

This chapter presents the test data results collected from six cross sectional cohort groups and interprets the impact of the instructional interventions on 5th grade TAKS results. The intervention of focused tutoring and science lab methodologies were implemented between cohorts three and four.

The great majority of the test takers whose data was reviewed and analyzed were 5th grade Hispanic students. Cohorts one (2003), two (2004), and three (2005) provided base line data while cohorts four (2006), five (2007) and six (2008) involved data results analyzed after the intervention. This quantitative study utilized TAKS results as the data analyzed to determine results of the impact which focused tutoring and science lab methodologies had on student performance.

The superintendent and the elementary school principal of the district that participated in this study were informed that the results would be available for them to utilize in implementing interventions that might prove beneficial in the area of science.

The investigation was driven by the following research question and tested two null hypotheses:

*Research Question*

What are the effects of focused tutoring and science lab methodologies on student performance in science?

*Null Hypothesis 1.* There is no difference among cohort means.

*Null Hypothesis 2.* There is no difference between pre-treatment and post-treatment means.

*Demographic Profile of Participants in the Study*

The population studied was selected from all students in the fifth grade who took the science TAKS test during the 2003 through 2008 school years in an elementary school in South Texas. A table of random digits was utilized to select from a total of 577 students for the study of six years of data. The total cohort enrollment per year ranged from 80 to 115 students and approximately 30 students who were tested on the $5^{th}$ grade TAKS test were selected per cohort for this study.

Through simple random sampling, a group of 30 students were drawn from the total population for each of the six years studied. All the individuals in the defined population had an equal and independent opportunity of being selected into the sample.

The coding of students involved identifying and defining the population to be studied. A desired sample size of approximately 30 students was selected from all

members of the 5th grade population for each of the six years studied. Individual students were assigned consecutive numbers, with representation of the same number of digits per student. This helped to identify the sample score to be selected. The researcher selected an arbitrary number in the table of random numbers which identified the student and score to be used.

*Research Findings*

At the study site, of the total number of students tested in 2003 (year 1), twenty-two percent (22%) passed the Science TAKS section. Forty-Five percent (45%) passed the Science TAKS section in 2004 (year 2), and forty-three percent (43%) passed the Science TAKS section in 2005 (year 3). These test scores reflect the total percentage of students passing the Science TAKS test in each of the three cohort years prior to the intervention of focused tutoring and science lab methodologies.

In 2006 (year 4), the study site implemented the interventions of focused tutoring and science lab methodologies. That year a total of sixty-nine percent (69%) of the students tested passed the Science TAKS section. The interventions continued in 2007 (year 5) and the data showed that seventy-two percent (72%) of the students' tested met minimum expectations or passed the test. Eighty-three percent (83%) of the students in 2008 (year 6) met minimum expectations. These test scores reflect the total percentage of students passing the Science TAKS test in each of three cohort years after the implementation of focused tutoring and science lab methodologies. Table 2 contains a summary of the total number of students tested and the total percentage of students who passed the Science TAKS test before and after implementation of treatment. Figure 2 plots and compares gains of the percentage of students passing the 5th grade Science

TAKS test per cohort.

Table 2

*Campus totals- number of students tested/met expectations/percent passing for each cohort year.*

| | Students | | |
|---|---|---|---|
| Year | Tested | Met Expectations | Percent Passing |
| 2003 | 72 | 15 | 22% |
| 2004 | 110 | 51 | 45% |
| 2005 | 103 | 43 | 43% |
| 2006 | 98 | 70 | 69% |
| 2007 | 106 | 77 | 72% |
| 2008 | 88 | 73 | 83% |

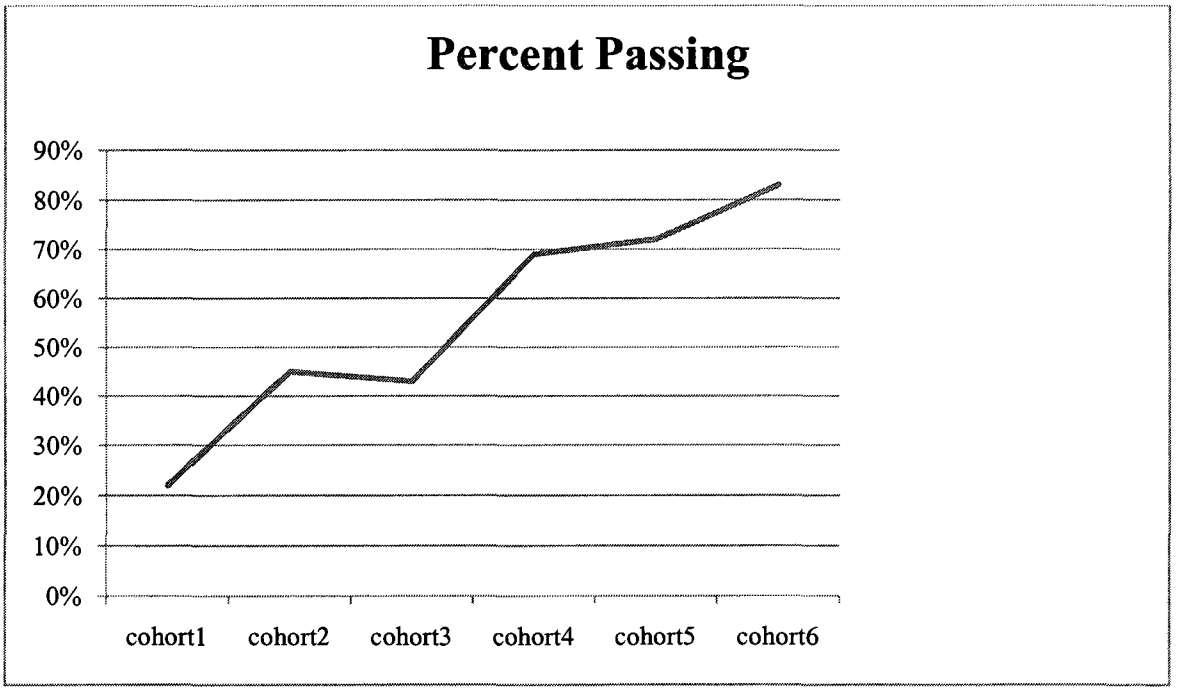


*Figure 2.* Cohort percent of students passing 5th grade science TAKS.

*Groups Before/After Instructional Interventions*

A univariate analysis of variance was conducted to analyze the data. The obtained data was analyzed using a one-way analysis of variance (ANOVA). The null hypothesis was tested with a *F* distribution and the level of significance was set at .05. A trend analysis and curve fitting was utilized to assess the six data points. Based on the results from the study a one-way analysis of variance (ANOVA) was used to determine the total variance between groups (variance caused by the treatment groups) and variance within groups (error variance). Table 3 delineates this information and shows that there is a significance of the *F* distribution of 13.31 which indicates a significant difference between pre-treatment and post-treatment groups.

Table 3

*Summary table of pre-treatment and post-treatment means (ANOVA).*

| Source of Variation | SS | df | MS | F |
|---|---|---|---|---|
| Between Groups | 1749269.67 | 5 | 348953.93 | 13.31* |
| Within Groups | 4574445.53 | 174 | 26289.92 | |
| Total | 6323715.20 | 179 | | |

*p>.05

Further, the two null hypotheses were tested. The first null hypothesis was that: The test showed that there is no difference between pre-treatment means and post-treatment means. There were no significant differences found between cohort 3 and cohort 4 immediately following the instructional intervention (as shown in Graph 2). A significant difference emerged as the implementation of the intervention continued through cohorts 5 and 6 while a small increase was evident between cohorts 4 and 5. This

smaller increase is largely due to the fact that the implementation of any educational intervention becomes positively evident as the consistency of implementation continues through the years. Thus the null hypothesis was rejected in that there was a difference between pre-treatment means and post-treatment means (E= 13.31) (p>.05).

The second null hypothesis was that: There is no difference among pre-treatment means and post-treatment means. The study revealed that a difference in TAKS results was evident through cohort 5. Although an increase in scores appeared following cohort 4, the significant gain in scores emerged after cohort 5 and cohort 6 were tested (as shown in Figure 3). The pre-treatment group means (cohorts 1, 2 & 3) scalescores are significantly lower than the post-treatment means (cohorts 4, 5 & 6). The intervention of focused tutoring and science lab methodologies proved positive in an increase of scores on the post treatment cohorts (4, 5 & 6). Thus the null hypothesis was rejected in that there was a difference among pre-treatment means and post-treatment means. This information is presented in Figure 3.

*Cohort Means of Scale Scores*

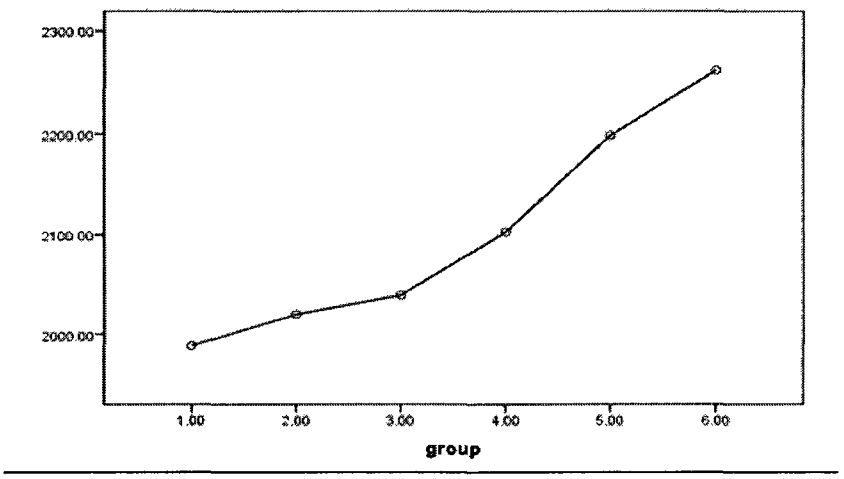


*Figure 3.* Cohort Means of Scale Scores

*Performance Analysis for 2003, 2004 and 2005 School Year*

Since science had not been mandated as a state test in 5th grade until 2003, students in the first three cohorts consisted of a population that had not been prepared with the interventions of focused tutoring and science lab methodologies. Thus, intervention occurred between cohort 3 and 4. The students were being instructed in Science by their classroom teacher while whatever lab methodologies may have been used were in the classroom and not in a lab setting. It is essential to point out that the teachers involved in the first three cohorts were the same teachers involved with the delivery of instruction for the last three cohorts. Therefore, it appears that any positive or negative effect the intervention may have had on student performance was based primarily on the implementation of the intervention.

*Performance Analysis for 2006, 2007, and 2008*

In 2006, focused tutoring and science lab methodologies were implemented for 5th grade students. Students received classroom instruction while receiving intense tutoring three times a week. The tutoring sessions consisted of one on one instruction for a total of thirty minutes per day. The lab setting was separate from the classroom. Specific hands on methodologies were implemented to ensure mastery of objectives by the students. The students attended lab twice a week for a total of forty five minutes. The teacher could also determine if additional lab instruction was needed and scheduled students to attend lab at other scheduled times. The study site had a teacher assigned to the lab to supplement the regular classroom instruction with an instructional assistant to help monitor. The administration organized 5th grade science instruction in this fashion in an effort to increase scores in the area of science.

*Exploratory Data Analysis*

Exploratory data analysis was utilized to examine the raw data. The researcher implemented this procedure to look for important patterns and phenomena which otherwise might not be revealed. According to Gall, Borg & Gall (1996), statistical techniques for examining patterns and phenomena in individual scores have been developed. These techniques which are known as exploratory data analysis are methods used for "discovering unforeseen or unexpected patterns in the data and consequently [for] gaining new insights and understanding of natural phenomena." According to Tukey (1977), exploratory analyses are conducted for the purpose of detecting atypical data and distributions in the study.

The researcher collected and quantified the data prior to beginning exploratory data analysis. The stem-and-leaf plot for each individual cohort was analyzed to interpret the shape of the distribution of scores (Appendix C). The data did not display any apparent outlier scores. An outlier is an individual's score whose score differs markedly from the scores obtained by other members of the sample (Gall, Borg & Gall, 1996).

In the statistical analysis described in Table 4, the mean, which indicates the average performance of a group and the standard deviation, which refers to how spread out the set of scores is around the mean, were analyzed using an analysis of variance. A one-way analysis of variance was utilized to analyze the difference among the means for the six cohorts. The data was further analyzed to determine the mean difference between cohorts. The mean difference between cohort 1 and cohort 3 is 50.83, the mean difference between cohort 1 and cohort 6 is 237.27. This indicates that as the interventions were implemented there was a larger discrepancy of means between cohorts.

Students' higher scores in the 5th grade Science TAKS test in cohorts 4, 5 and 6 in comparison to the earlier cohorts seem to have been impacted by the interventions implemented. This mean difference between cohorts data is fully displayed in Table 5.

Table 4

*Scale score means and standard deviations for cohorts.*

| Cohort | Mean | Standard Deviation |
|---|---|---|
| 2003 | 1988.57 | 126.05 |
| 2004 | 2019.93 | 143.22 |
| 2005 | 2039.40 | 177.32 |
| 2006 | 2102.53 | 193.24 |
| 2007 | 2198.13 | 139.35 |
| 2008 | 2261.83 | 182.03 |

Table 5

*Mean difference between cohorts.*

| | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|---|
| 2003 | | 31.37 | 50.83 | 113.97 | 209.57 | 237.27 |
| 2004 | | | 19.47 | 82.60 | 178.20 | 241.90 |
| 2005 | | | | 63.13 | 158.73 | 222.43 |
| 2006 | | | | | 95.60 | 159.30 |
| 2007 | | | | | | 63.70 |
| 2008 | | | | | | |

The mean difference between cohorts seems significant among pre-treatment cohorts and post-treatment cohorts. This is especially evident in cohorts 1 (2003) and 2 (2004) in comparison to cohorts 4 (2006) and 5 (2007). This appears to be a result of the interventions being implemented within cohort 4, 5 and 6. These results suggest that the interventions of focused tutoring and science lab methodologies had a positive impact on 5th grade student performance on the Science TAKS test.

*Summary*

This research study can be used to generalize the impact of focused tutoring and science lab methodologies on 5th grade student performance on Science TAKS tests. This study utilized exploratory and confirmatory analysis; descriptive statistics such as mean and standard deviation were gathered for each cohort. In addition, exploratory data analysis and stem-and-leaf displays were obtained. This study demonstrates that the implemented instructional interventions of focused tutoring and science lab methodologies led to significantly better achievement and also suggests that improvements might result from continuing the implementation of the strategies. Chapter V provides further discussion of the findings, conclusions, implications and recommendations for further study.

# CHAPTER V

The main purpose of this study was to examine the impact that focused tutoring and science lab instructional strategies had on 5th grade student performance in science in an elementary school in South Texas. This chapter summarizes the study and discusses the findings based on the quantitative data collected and analyzed by the researcher. The study determined whether focused tutoring and science lab instruction, which was not implemented until the last three years of the six years studied, made an impact on student performance in Science as measured by TAKS scores in 5th grade for an elementary school in South Texas. This chapter presents conclusions, implications and recommendations for further research.

The underlying reason for the conduct of this research was the need to determine the effect that focused tutoring and science lab methodologies had on 5th grade student performance in science. The research analyzed six different cohorts to determine if focused tutoring along with science lab methodologies impacted scores for the last three cohorts. This quantitative study was conducted for the purpose of evaluating the impact that focus tutoring and science lab methodologies have on student performance in science as measured by Texas Assessment of Knowledge and Skills (TAKS) in the State of Texas. The researcher intends to make this study useful for further research, but most importantly, for campus and district administrators, who search for instructional support in improving student performance in science.

*Conclusions*

There were a couple of limitations that merit discussion in this conclusion section. The first limitation was the fact that the study took place in the lower Rio Grande Valley of Texas. The results are reflective of the population. The scores that were utilized for the study came from a majority 5th grade Hispanic population. Although the study looked at a specific school, the setting is considered unique in comparison to other schools in the district due to its large low socio-economic population. However, other schools in the lower Rio Grande Valley are not dissimilar in size or socio-economic population. Thus one could conclude that to some extent, this study could be of benefit for administrators serving similar student populations and seeking additional interventions to improve 5th grade student performance on the Science TAKS test.

A second limitation is the knowledge base of teachers in science content. Although, the teachers in the study were consistent through the last three cohorts, the training provided for each teacher varied. Good and well trained teachers of science organize environments in which they work collaboratively with their students in creating active learning. Through staff development, teachers gain continually expanding theoretical and practical knowledge in the area of science. The training a teacher may have received in the area of science can be reflective on the tutoring strategies implemented by the teacher which may result, in this study, as a limitation. As indicated in the review of literature, improvements in the curriculum or ways in classroom organization would not be productive unless teachers understand and believe in the concepts and materials being presented and have the necessary knowledge to adapt the curriculum and classroom structures to student needs (Fullan, 2000).

Also, the implementation of science labs with science lab methodologies reflects implementation with the last three cohorts. The first three cohorts were exposed to lab methodologies in the regular classroom versus a fully equipped lab setting during the last three years. The focused lab approach proved successful, this is consistent with the research of the National Assessment of Governing Boards which states that it is essential that students learn science by involvement in the scientific inquiry process. It appears that a fully equipped lab, with the practice of involving students in the inquiry process for science, results in a higher knowledge base for students.

Finally, the students exposed to focused tutoring and science lab methodologies scored higher on the 5th grade Science TAKS test in comparison to students in the first three cohorts which were not exposed to such interventions. It is apparent that when educators plan tutoring with a specific focus and expose students to the inquiry process for science positive results emerge.

*Implications*

Since schools across the state of Texas, and in the Rio Grande Valley, in particular, demonstrate deficiencies in science literacy as compared to national standards, administrators in South Texas schools need to focus on providing students with the best instructional interventions. Awareness by administrators, of how to implement focused tutoring and science lab methodologies will prove beneficial for both the students and teachers. Based on the research, approaching the improvement of science education by simply changing textbooks or adding a new course will not work (Donahue, 2000). Furthermore, as indicated by the results of this study, the need for fully equipped science labs and tutoring which is focused on the individual needs of a student in the area of

science could result in higher student achievement in the area of science.

Additionally, the success of a student in the area of science largely depends on how engaged they have been in the scientific inquiry process. This is in agreement with prior research by Motz, Biehle, & West (2007) which concluded that, "In order to enable excellence in science education, well designed science facilities must be in place in our schools" (p.). It is through this process that educators involve the students in using the necessary tools while collecting data. Educators must keep in mind that students learn science as a process of inquiry which includes observation and imagination of the phenomena which is being studied (Donahue, 2000). This study supports Donahue's conclusion in which focused tutoring and science lab methodologies provide students with the necessary instructional support to be successful in the area of science.

Futhermore, students involved with one on one tutoring instruction demonstrate higher mastery of objectives versus students taught in whole group instruction alone. The research does suggest that, supplementing regular classroom instruction with additional tutoring in the content area in which the student is deficient will increase mastery of objectives. At the study site, focused tutoring involved the student receiving one on one tutoring four times a week. These implications of success suggest a number of recommendations for practitioners and researchers alike. Some of these recommendations follow.

*Recommendations for Further Research*

This research study has many interrelated topics which merit further research. The researcher found minimal research on the effects of tutoring on instruction. The literature is especially sparse in the area of science lab methodologies and the impact on

student achievement. Consequently, it is imperative that further research be conducted in the effort to increase the literature and knowledge of related issues for increased student performance in science and other disciplines. Some of the related questions which beg for answers are:

- This research focused on science performance. Would focused tutoring, as implemented in this study, improve performance in other content areas?
- The findings indicate that focused tutoring and science lab methodologies have a positive impact on student performance. What major implications does this have for administrators who are experiencing low scores in the area of science?
- The training in the area of Science varied among the teachers. What implication does the level of training a teacher has in the area of Science impact Science TAKS scores?
- Scores utilized in the study were of 5$^{th}$ grade students who tested in Science TAKS. Does the lab setting, which may differ the following year, impact science performance when students are in the middle school and are in a different setting?
- This research indicates that a separate lab setting has a positive impact on student performance. Does departmentalization at the 5$^{th}$ grade level impact student achievement?

*Summary*

Through the review of the literature and the results of this study, several final conclusions can be drawn.

- Focused tutoring and science lab methodologies, in addition to regular classroom instruction, have a positive impact on student achievement.
- Students exposed to science lab methodologies, in addition to science classroom instruction, scored higher on the 5th grade Science TAKS test.

The data indicates that 5th grade students who were instructed with focused tutoring and science lab methodologies outperformed the students who did not receive those instructional interventions on the science TAKS test. The demographic data for this school indicates a large population of low socio-economic, Hispanic students. It appears that the last three cohorts of 5th grade students benefited from focused tutoring and science lab methodologies as evidenced by the results on TAKS tests.

The Educational Testing Service, (1988) cries that far too many young Americans are emerging from our nation's elementary and secondary schools with an inadequate grounding in science. As a result of this study, an elementary school in South Texas implemented focused tutoring and science lab methodologies to help students acquire the necessary skills in 5th grade Science. The implementation of those two interventions strongly indicates a positive impact on 5th grade student performance on the Science TAKS test. The results also clearly suggest that school principals should seriously consider implementing these approaches in order to improve student performance in Science in their respective schools. Perhaps these two interventions in the teaching of science in elementary schools will at least partially address the cry of the Educational Testing Service.

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# APPENDIX A

# Appendix A

Stage I: In this stage, the tutor is to provide the student with a demonstration. The tutor needs to model the task that the student is to complete.

Stage II: In this stage, the tutor is to provide the student with explicit instructions. The tutor needs to explain all necessary information to the student and provide additional demonstration and examples as needed.

Stage III: In this stage, the student attempts to mimic the behavior that was modeled by the tutor. The tutor is beginning to fade out the assistance. With the tutor's help, the student can properly execute the task being learned.

It is within stages I, II, and III that the majority of actual tutor instruction must fall in order for a student to experience the maximal amount of growth. During these stages, students do the most learning.

Stage IV: In this stage, a student is able to master and complete a task independently. While most actual learning takes place in stages I, II, and III, stage IV allows a student to solidify knowledge and demonstrate his or her mastery level. Mastery of task independently often helps the student feel a great sense of confidence and competence. If the student has not mastered the task, then stages I, II, and III should be revisited using modified instruction, until the student demonstrates mastery in stage IV.

As a summary of scaffolded instruction, a tutor models behavior for a student while a student observes. With help, the student then mimics the tutor's behavior. As the student

begins to grasp learned concepts more and more, the tutor fades out instruction until the tutor is simply watching the student independently perform the behavior that the tutor originally modeled.

# APPENDIX B

# APPENDIX B

## Principal Questionnaire

1). What instructional interventions is your school implementing to address the science Texas Assessment of Knowledge and Skills (TAKS)?

2). How often do your $5^{th}$ grade students attend science lab?

3). How often do they receive tutoring in the area of Science?

4). Who is in the lab with the students for instructional purposes?

5). Who provides tutoring for the students?

# BIOGRAPHICAL SKETCH

Annabelle Palomo-Rodriguez was born in Mcallen, Texas on June 28, 1967, the daughter of Miguel and Graciela Palomo. Upon graduating from Pharr-San Juan-Alamo High School in 1985, she enrolled at Pan American University where she earned a Bachelors of Science Degree in Education in 1989. She began her teaching degree as an elementary teacher with the PSJA ISD from November of 1989 to December 1993. While working as a teacher, Annabelle pursued and earned a Master of Education degree in Educational Leadership from the University of Texas-Pan American in Edinburg, Texas. She was immediately hired with the Weslaco ISD as an administrator serving as an instructional facilitator and assistant principal before being named principal at Beatriz Garza Intermediate in 1997. Annabelle served as principal to the "Exemplary Campus" for 5 years prior to moving to Central Office. In 2003, Annabelle was named Curriculum Director and a year later Executive Director for Curriculum and Instruction. She was employed with Weslaco ISD for 13 years prior to pursuing a career as an educational consultant. Annabelle currently owns RGV Careers-An Institute of Higher Learning which primarily educates students in the Allied Health Field, and recently was approved by the Texas Board of Nursing for the Vocational Nursing program. She continues to provide educational training while acting as CEO for RGV Careers. She completed her requirements for the Doctor of Education degree at the University of Texas-Pan

American in August of 2009. She resides at 2810 S. Jackson Rd in Edinburg, Texas with her beautiful daughter Annika S. Rodriguez.